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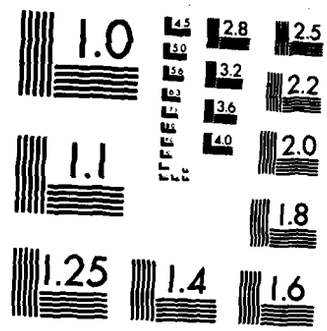

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Today, scientists at the US Army Engineer Topographic Laboratories (ETL) are investigating mapping applications of optical storage technology. Research efforts at ETL over the last several years have shown that a great potential exists for interactive optical video disc systems in storing and displaying maps, photographs and other graphic materials. ETL's resident demonstration video disc system has served well but cannot be easily adapted to new mapping applications. A new system being developed at ETL uses state-of-the-art Direct Read After Write (DRAW) video disc technology for in-house recording of video discs. ETL's hybrid approach to

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DATA STORAGE BRINGS ANALOG AND DIGITAL MAPPING DATA TOGETHER FOR THE FIRST time on the same video disc. Planning and production operations for video discs are being streamlined and cartographic standards are being developed to improve the quality of video map displays.

REALIZING THE FULL POTENTIAL OF THE VIDEO DISC FOR MAPPING APPLICATIONS

Robin B. Lambert

United States Army Engineer Topographic Laboratories

Fort Belvoir, Virginia 22060-5546

BIOGRAPHICAL SKETCH

Mr. Lambert is a cartographer with the US Army Engineer Topographic Laboratories. A project engineer in the Automated Cartography branch, he is currently responsible for developing mapping applications of video disc technology. From late 1980 to mid-1984, Mr. Lambert was employed by the Defense Mapping Agency Hydrographic/Topographic Center in Louisville, Kentucky. He holds degrees from Bowling Green State University of Ohio (M.A. 1980) and the State University of New York at Buffalo (B.A. 1978).

ABSTRACT

Today, scientists at the US Army Engineer Topographic Laboratories (ETL) are investigating mapping applications of optical storage technology. Research efforts at ETL over the last several years have shown that a great potential exists for interactive optical video disc systems in storing and displaying maps, photographs and other graphic materials. ETL's resident demonstration video disc system has served well but cannot be easily adapted to new mapping applications. A new system being developed at ETL uses state-of-the-art Direct Read After Write (DRAW) video disc technology for in-house recording of video discs. ETL's hybrid approach to data storage brings analog and digital mapping data together for the first time on the same video disc. Planning and production operations for video discs are being streamlined and cartographic standards are being developed to improve the quality of video map displays.

INTRODUCTION

For the past several years, scientists at the US Army Engineer Topographic Laboratories (ETL) have been investigating potential mapping applications for optical storage technology. These investigations have shown that the video disc is a viable medium for storing and retrieving mapping data. An interactive video disc system can provide the ease and flexibility for maintaining a collection of maps, photographs and related information that civilian and military users alike are looking for. There are

limitations to this medium, as our investigations at ETL reveal. The first mapping video disc project that involved ETL scientists back in 1983 proved to be a good learning experience, helping to shape later investigations.

THE VIDEO DISC DEMONSTRATION SYSTEM

ETL's current mapping video disc system was originally developed in 1983 for demonstrating the storage and retrieval capabilities of a micro-computer controlled laserdisc player reading a video disc containing over forty-thousand images of maps, graphics and photographs. This video disc was produced in 1983 as one of ETL's initial optical video disc tasks. It represented a joint effort with the US Army Corps of Engineers Water Resources Support Center, the US Geological Survey National Cartographic Information Center and the US Navy Civil Engineering Research Laboratory. The video disc contained images selected by each of the co-producers. This project provided ETL scientists with a good understanding of the logistics involved in producing a mapping video disc.

The unique problems associated with putting mapping data on a video disc had not been fully known until actual production work had started. Problem areas encountered during production, testing and evaluation include the lack of cartographic standards for video maps, disc content, planning and production methods, software development and hardware compatibility. The completed video disc did, however, reveal the applicability of this medium for the storage, retrieval, display and manipulation of mapping data.

A second video disc, now undergoing test and evaluation, has been produced with marked improvement in all areas over the initial attempt. The second disc will serve to support highly refined demonstrations of the capabilities of interactive video disc systems. It is important to remember that both of these discs are designed as demonstrators; that is, they are not intended to be used apart from the video disc demonstration system. They are dependent on the software that has been developed to provide specific computer-controlled demonstrations. The software will only run on our custom-built micro-computer, thereby restricting at least the initial demonstrations to be performed on the ETL facility.

Recognizing the limitations of our present system, it became clear that a more versatile and expandable system was needed. Central to this concept was the desire to keep it simple, using compatible off-the-shelf components. State-of-the-art hardware would be needed. A user-friendly micro-computer compatible with other systems and many peripherals, and capable of running many programs, would be essential to this system. Direct Read After Write (DRAW) technology was considered essential for the video disc component of the system. This technology would allow in-house recording of video discs without having to

contract out for disc mastering and replication services. A plan was formulated that addressed all of the issues pertinent to designing a system that was not limited to providing just a small number of canned demonstrations. The system would be a testbed for wide-ranging mapping and map-related applications.

Such a system would be needed to exploit the true potential of the video disc for mapping applications. Up to this point, disc content had been limited to video images stored in analog form. Why not expand the range of mapping data stored on the disc by adding digital data? Digital terrain elevation data (DTED) was determined to be a good candidate for storage on a DRAW video disc. Once it is stored on the disc, DTED can then be used to generate 3-D perspective views corresponding to the video map images stored on the disc and generate terrain masking displays for fields of fire. The software needed to generate these displays is already available and will be modified to run on our system.

THE HYBRID DRAW VIDEO DISC SYSTEM

Interest in developing and demonstrating more fully the potential of video disc technology for mapping applications on a more powerful video disc system culminated in two studies. The first study, underway since late 1984, has concentrated on the storage, retrieval, manipulation and display of digital data using a DRAW video disc system. This has been named the Hybrid DRAW study since, for the first time at ETL, digital data bases have been stored on the video disc with the analog images of maps, photographs and text. In addition, the operating system software would be stored on that same disc. Also considered in this study are functional/performance requirements, and a cost analysis.

A closer look at the Hybrid DRAW study reveals the direction that our video disc program is headed. We are heading toward the development of a potentially effective tactical decision aid and briefing tool. To accomplish this, we have identified three (3) characteristics for all-new system.

Initially, the video disc must be integrated into a micro-computer controlled system. While this may appear to be an obvious conclusion, the only way to realize the full potential of an interactive video disc system is to develop software for the micro-computer that will access most efficiently the stored mapping information. For example, the same information stored on the video disc can be accessed in a different way or sequence for each user. A single video disc or a set of video discs can be accessed by any number of users; each one accessing the disc or discs with his own application software.

Secondly, information stored on the disc must be categorized as to its permanence. The read-only replicated disc is a permanent storage medium. The resident information is unalterable and cannot be erased. This holds true for DRAW

video discs as well. The DRAW disc can have information added, provided there are blank tracks available. For either type, however, the resident information is permanent. This being the case, mapping information destined for video disc storage should be viewed as being permanent and not requiring frequent changes. Planimetric bases, relief data, and topographic features may not change often. On the other hand, cultural features, such as transportation networks, obviously are more dynamic. There must be a provision for updating any dynamic information stored on the video disc. A magnetic disc may be needed to maintain a record of updates until a video disc can be prepared that contains the updated map graphics or text.

Knowing the relative permanence of the information stored on the video disc can be part of a strategy to segregate mapping information. Static information can reside on a disc that will be filled to capacity. Dynamic information can be spread over several discs, each having a predetermined number of blank tracks to accommodate updates. There are two drawbacks to this approach. Storing dynamic information on several partially-filled video discs reduces storage available for permanent information for each disc and also requires having two or more disc players in operation at the same time for immediate access of any available information. There may be applications for which this approach is acceptable, and we will look into this further. For our hybrid DRAW system, regardless of how the video disc storage space is allocated, it appears that until an erasable video disc is available a magnetic disc will have to be incorporated into the system to maintain files for updating.

Thirdly, the video disc system must meet certain high-level criteria. System compatability and flexibility are necessary. This will be largely determined through good choices of hardware and software. Flexible software programs will be needed for information management. The storage and retrieval of analog and digital mapping information is necessary. The hybrid approach to information storage, as already described, will be adopted here. In-house recording of this information on a DRAW video disc is necessary for future applications development.

The second study, for the Hybrid DRAW system, will evaluate the specific software and hardware choices made in the first study. The impact of these choices on issues such as frame referencing and hardcopy output of display information will be examined.

VIDEO DISC PLANNING AND PRODUCTION

Commercial video disc production, mastering and replication procedures are well-known and are considered very reliable. Exacting mapping requirements, however, can disrupt an otherwise smooth video production. In the discussion of ETL's first mapping video disc, planning and production were two operations identified as problem areas. This needn't be so. Planning and producing a mapping video disc

should be functions of the application for which it is intended. A well-defined application or set of applications will dictate a disc layout that is best-suited for the job. Tight production specifications designed for that application or set of applications can keep costs to a minimum and reduce turn-around time. This was evidenced during the production of our second video disc. Difficult filming sessions and an inferior product can usually be traced back to (a) a poor concept of what the video disc was intended for, (b) inadequate planning and scheduling, or (c) both. ETL scientists have prepared a comprehensive standards document for the production of optical video discs to minimize future problems.

An example of a production operation that calls for extensive planning is that of filming the panning and zooming sequences for a mapping video disc. The National Television Standards Committee (NTSC) 525-line broadcast video format poses a serious limitation to preserving fine detail on maps and graphics. The low resolution displays of standard television monitors do not faithfully reproduce maps in full detail at original map scale. Therefore, small map sections must be filmed, appearing as greatly-enlarged images when accessed from the completed video disc and displayed on the monitor. Early ETL research led to the filming of 2" x 3" map units for finely detailed, 1:50,000 scale topographic maps. To assist the user in reading the map, now dissected into hundreds of small units, panning and zooming techniques were devised. Zoom techniques allow the user to locate oneself on a larger, less readable map section, and then move in for a closer look at a selected 2" x 3" map unit that fills the screen. Panning techniques allow the user to move around the map at a particular zoom level. Smoothness of the panning operation is a function of the amount of frame-to-frame overlap. Horizontal and vertical panning directions are standard although diagonal panning is also possible with additional filming. Both the panning and zooming techniques have been researched, developed and applied at ETL and elsewhere and will not be addressed further here. One factor common to all panning and zooming techniques used in the display of maps from video discs is that they involve sequential accessing of stored frames, i.e., they do not represent digital movements. The panning and zooming sequences must be finalized before filming begins. The filming process itself has been automated largely with computer-controlled camera systems. Their accuracies make possible excellent frame-to-frame registration for the 75 percent overlap frame sequences provided the materials are properly edge-matched and mosaicked prior to filming.

In-house recording sessions using DRAW video discs may not achieve the same accuracy as commercially-prepared discs, especially if the maps, photographs and text materials are being recorded directly from a video camera input. Special in-house techniques may have to be devised as applications of DRAW video disc technology are explored further.

CARTOGRAPHIC STANDARDS

ETL's development of mapping applications for the video disc has fostered two map graphics design studies. These studies are concerned with identifying the cartographic products that are best-suited for video display. A basic map graphics study was completed in mid-1984. This study defined the now well-known 2" x 3" map capture unit for filming 1:50,000 scale topographic products. The study indicated that more research was necessary to identify the optimum sizes for map symbols and lettering. The influence of color on video map images was identified as a factor that could affect map communication. De-cluttering standard map products was suggested as a way to simplify the video images for overlaying with computer graphics displays. An advanced map graphics study, now underway, is addressing these cartographic concerns.

The principal issue in designing maps for video display is legibility. Point, line and area symbology, lettering and color usage are all factors that will be tested and evaluated for ease of recognition and visual communication when maps are viewed on a standard television monitor. The subject of the advanced graphics study is a 1:50,000 scale topographic map product.

Symbol types and sizes will be tested and evaluated for video display. Type styles and sizes will be treated in the same way. Re-orientation of symbols and type on the map sheet will be attempted in an effort to improve legibility in particularly dense areas. Tests will be conducted to identify any map color that is either intensified or subdued by the video system and identify any color on the display that is not being interpreted as the color on the original map.

Scale indicators will be evaluated and one will be selected for use on video map frames. Intuitive reasoning favors the graphic bar scale through fractional and representative fraction scale indicators will be tested and evaluated as well. Size, placement, color and ease of re-location on the screen are all factors to be considered.

Finally, de-cluttered color proofs of the entire 1:50,000 scale map sheet will be prepared. These will be made from color separation negatives and feature separates, prepared from these negatives, to maximize the number of possible combinations. The negatives will be re-composited with with one or more separates deleted to make the de-cluttered color proofs. Sections from each of the color proofs will then be filmed and displayed on a standard television monitor and the images will then be evaluated for ease of recognition and visual communication. This advanced map graphics study, when completed, will provide the basis for the careful selection and preparation of maps for video display.

CONCLUSION

The video disc program at ETL is growing and much progress has been made already in developing mapping applications of this technology with out video disc demonstrators. We are involved in technology transfer with government agencies and businesses more frequently now that general interest in optical media widens. Future studies of the video disc at ETL will need to be responsive to practical field applications. Potential users within the US Government will continue to be identified and briefed on our system and our in-house capability to develop/identify mapping and map-related applications. We will continue to refine our video disc system and intensify our efforts to stay abreast of advances in technology. The anticipated release of a commercially-available erasable video disc in the next few years is expected to foster development of new mapping applications. Further down the road, the optical disc may hold the key to total digital storage, retrieval, display and manipulation of mapping information. Wherever future research in optical storage technology leads, ETL scientists will be there to identify, demonstrate and develop innovative mapping applications.

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